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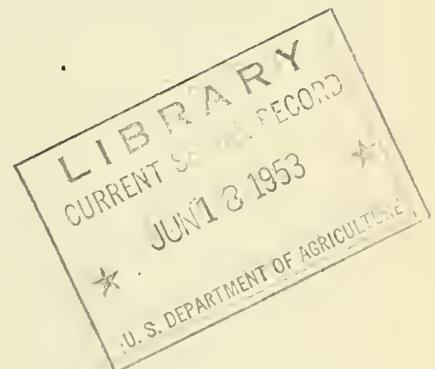
H. T. & S. Office Report No. 289

X Shipping and Ripening Tests with Texas Tomatoes, June 1952 X

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Harlingen, Texas  
April, 1953



## Shipping and Ripening Tests with Texas Tomatoes, June 1952

### Object

A desirable transit temperature range for tomatoes is 50° to 65° F. Temperatures within this range prevent excessive ripening, hold decay to a minimum, eliminate the possibility of chilling injury in the coldest part of the load, and shorten the time normally required for the tomatoes to ripen after reaching the receiver.

A limited number of shipping tests have been conducted during the past several years to determine the effectiveness of methods used in shipping Texas mature-green tomatoes loaded warm. The results from earlier tests revealed that upper half stage icing under standard refrigeration from south Texas to Jersey City, New Jersey gave temperatures comparable to full bunker icing. Both of these services provided over-refrigeration for tomatoes. The tests also included cars in which the usual service was modified to determine the icing and ventilation services best adapted for use. From these tests with modified service, one car shipped in 1951 from Hallettsville, Texas to Jersey City, New Jersey showed the desired moderate transit temperatures. This car with fans operating was initially iced and reiced once (Rule 247) at Pine Bluff, Arkansas where diagonal vents were opened. A study of the temperatures obtained in this car indicated the desirability of modifying the service further, either by: 1, delaying the opening of vents; or 2, leaving vents closed to destination in cars shipped under Rule 247 (initially iced, reiced once) with the possibility of reducing the amount of ice used in reicing cars shipped with plugs in, vents closed to destination.

Unfortunately these protective services could not be tested in 1952. The icing and ventilation service for the test cars shipped in 1952 were specified by the buyer and are typical of the current protective service for tomatoes shipped from this area. Standard refrigeration with ventilation service was compared with a car initially iced and reiced once (Rule 247) and ventilated, and a fan car initially iced and reiced once (Rule 247) with diagonal vents opened after 18 hours.

### Procedure

Three test cars were loaded at Jacksonville and Rusk, Texas on June 13, 1952. Two of the cars were made available for the test so late that test lugs could be placed only in the top doorway location. In the third car two test lugs were placed in each of the two customary locations, namely, (1) bottom layer next to bulkhead; (2) top layer at doorway. These two locations are representative of the coldest and warmest part of the load during transit. A recording thermometer was packed in one of the two test lugs in each location. All test lugs were along the centerline of the load. The load in each car consisted of 700 standard lugs of wrapped, place-packed, 6 x 6 or larger, mature-green tomatoes. The tomatoes in the test lugs were from the same source.

The refrigerator cars used in the test were not selected. Two of the cars had been recently rebuilt and were equipped with Preco electric fans. The third was a standard end bunker car without fans. The bunker capacity in this car was approximately 17 percent less than cars 1 and 3.

Car 1 (PFE 8803) to New York City, although equipped with fans, moved under standard refrigeration with fans not operating and vents opened at Huntingdon, Pennsylvania. Car 2 (FGE 36748) to Jersey City was the standard end bunker car without fans. It was serviced according to Rule 247 i.e. initial and one reicing, and diagonal vents were opened at East St. Louis, Illinois. Car 3 (PFE 9483) to Chicago also was serviced under Rule 247 but with fan service, and diagonal vents opened at Pine Bluff, Arkansas.

The three cars were loaded the afternoon of June 13. They were initially iced at about the same time that loading was completed. During the loading period maximum fruit and air temperatures of 95°F. were observed.

The icing and ventilation service for each car as well as the amount of ice supplied and the time at each icing point are given in table 1. The cars were routed over the Cotton Belt to East St. Louis. Car 1 was not released at the loading point in time to move on the same train as cars 2 and 3. As a result its schedule to East St. Louis was 14 to 18 hours behind that of the other two cars. From East St. Louis to Jersey City car 1 moved via Wabash Railroad and Pennsylvania while car 2 was routed all the way by Pennsylvania. Apparently cars 1 and 2 were on the same schedule from East St. Louis to Jersey City. Car 3 was delivered to Chicago by the Illinois Central R. R.

### Results

Outside Temperatures - U. S. Weather Bureau daily temperature records for ten transit-point cities disclosed above-normal temperatures during the entire transit period. The above-normal temperatures ranged from 6 to 17 degrees and averaged 12 degrees plus for all ten cities.

Rate of Cooling - In figure 1 are given the temperatures recorded in the test lugs in the top doorway location for the first 72 hours in transit. The temperatures obtained in all three cars are comparable only for the first 18 hours at which time diagonal vents were opened on car 3 at Pine Bluff. During this period temperatures in the warmest part of the load had been reduced in car 1 from 93° to 84°F.; in car 2 from 94° to 87°; and in car 3, with fans operating, from 94° to 80°F. Temperatures in cars 1 and 2 remained comparable for 36 hours, or until the diagonal vents on car 2 had been opened at East St. Louis. At that time the temperatures had been further reduced to 72° and 79° in cars 1 and 2 respectively.

In car 1 (standard refrigeration, non fan) the recorded temperature in the top doorway lugs dropped slowly to 56°F. This temperature was reached 90 hours after loading. No further reduction in temperature occurred after vents were opened at Huntingdon, Pennsylvania. In car 2 (Rule 247, non fan) the top doorway temperature leveled off at 76° before starting a gradual rise 34 hours after diagonal vents had been opened at East St. Louis. The top doorway temperature continued to rise until a maximum of 85° was recorded when the car was unloaded in Jersey City on June 19.

The temperature in top-doorway lugs in car 3, which had been moving from Pine Bluff with diagonal vents open, had been reduced to 78°F. but had started to rise at the 36-hour point. The temperature continued to rise until a maximum of 83° was reached 21 hours later.

In figure 2 are shown the transit temperatures to Jersey City recorded in the top doorway lugs in car 1 (standard refrigeration, non fan) and car 2 (Rule 247, non fan).

Car 1, standard refrigeration with fans not operating, was the only car in which the rate of cooling in the coldest and warmest part of the load could be determined. Temperatures were reduced to 70°F. in the bottom bulkhead and top doorway test lugs within 13 and 39 hours respectively after initial icing. The minimum temperature in the bottom bulkhead location reached 41° which was much lower than desired. The top doorway temperature, however, remained within a fairly satisfactory range after its slow drop to 70° (fig. 3).

Arrival Inspection - Commercial arrival inspection of the top layer lugs at Jersey City revealed the following:

Car 1 (standard refrigeration) - 1% ripe, 10% turning; no decay.  
Car 2 (Rule 247) - 3% ripe, 12% turning; 1% decay.

#### Tomatoes in Test Lugs

Ripening Data - In table 2 are given the results of the unloading inspection and data on rate of ripening. The start of the ripening period varies with each car and corresponds with the date of unloading. No over-ripe fruits were found in any of the test lugs from the three cars. The highest percentage of firm ripe fruits upon unloading was found in car 3 which had the least cooling during transit. The difference in the rate of ripening displayed by the tomatoes from the warmest and coldest location in car 1 should be noted. After being held for 18 days 2.4 and 28.3 percent of the tomatoes from the two locations respectively had failed to ripen. An additional 3 and 7-day period was required to complete the ripening of each lot. Tomatoes from the top doorway location in car 1 ripened more slowly during the early part of the holding period than tomatoes did from the same location in car 2. However after 18 days the cumulative percentage of sound ripe fruit in each lot was nearly the same.

Decay - The total decay averaged 1.4 percent in the tomatoes from the top doorway lugs in each of the three cars (table 2). This figure includes the decay that developed during the transit and ripening periods. The total decay in the tomatoes from the bottom bulkhead lugs in car 1 (standard refrigeration) averaged 5.8 percent. In car 1 no decay was evident in the test lugs from either location when unloaded but developed during the ripening period. In contrast the decay shown for car 2 developed during the transit period with no additional increase during the long ripening period. All of the decay listed in table 2 for the tomatoes from cars 2 and 3 resulted from infection by high-temperature organisms. In car 1 high and low-temperature organisms were about equally responsible for the total decay.

### Discussion

The results from these three test cars show that protective services usually employed for Texas tomatoes do not provide desirable temperatures in transit.

The temperatures in car 1 as shown in figure 3, further emphasizes the fact that standard refrigeration furnishes over refrigeration and should be discontinued as a protective service for Texas tomatoes. The icing record for this car shows that during the first 24 hours 8000 pounds of ice were melted. During the next 29 hours 4800 pounds were melted, but only 2400 pounds were melted during the next 25 hours. While the temperatures in the top layers of the car were not undesirably low, those in the bottom layer were below 50°F. for 4½ days. This is not sufficient time to cause chilling injury, but it did delay the ripening of bottom layer fruits. It is believed that one reicing would have been sufficient for this car and that the 9000 pounds used in the additional 5 reicings was unnecessary.

Car 2, a non-fan car received moderate icing under Rule 247 (initial and one reicing), but the vents were opened before maximum benefits were received from the ice. Diagonal vents were opened at East St. Louis, approximately 36 hours after initial icing. The bunkers with 9600 pounds capacity were 3/4 full when the vents were opened. The top doorway temperature was about 79°F. when the vents were opened and the temperature was reduced only 3 degrees after that time. After the ice was melted by the incoming warm air the temperature of the load increased steadily and reached 83° by the time of unloading.

In car 3 (Rule 247) with fans operating, diagonal vents were opened at Pine Bluff only 18 hours from completion of loading and initial icing. The car was reiced to capacity at Pine Bluff. The benefits from this reicing was not reflected by any marked reduction in load temperature. The temperature in the top doorway lugs was reduced 2 degrees to 78°F. after diagonal vents were opened which is a "poor return" for the cost of 11,500 pounds of ice. More effective refrigeration would have been obtained with vents closed for a longer period or perhaps to destination.

The temperature curve for car 2 when compared with that of car 3 (fig. 1) shows a much slower rise after the vents were opened. This is probably accounted for by the fact that the vents in car 3 were opened 18 hours earlier than those in car 2. Bunker inspection at East St. Louis showed that the bunkers of car 3 were empty, whereas there was 7200 pounds of ice in car 2 which had the vents closed to East St. Louis.

### Summary

Tests were made on three cars of mature-green tomatoes shipped from East Texas to Chicago and New York in June 1952.

Above average normal-temperatures prevailed during the entire transit period.

Standard refrigeration provides over-refrigeration and should be discontinued as a protective service for Texas tomatoes.

Modified icing under Rule 247 (initial and one reicing) failed to cool the loads in the top doorway sufficiently because cars were ventilated too soon.

Top doorway temperatures (76° to 78°F.) in cars 2 and 3 (Rule 247) never fell below the optimum range for the organism causing bacterial soft rot.

The accelerated rate of ripening observed in fruit from the top doorway location in cars 2 and 3 did not compensate for the involved risks with high-temperature decays.

The tomatoes from the top doorway in car 1, which had moved within the desired 55 to 60° range, ripened nearly as fast as those from car 2 which had experienced potentially dangerous transit temperatures.

Icing requirements should be determined primarily by the temperature of the tomatoes when loaded. Further tests are needed to determine the amount of ice required and the timing of ventilation. Current plans include testing cars serviced under Rule 247; (initially iced and 1 reicing) some with vents closed to destination, others with diagonal vents opened after about 72 hours.

#### Acknowledgments

These shipping tests were made possible by the cooperation of the Atlantic Commission Company and the Harry Klein & Company.



Table 1. Icing and Servicing Record for Test Cars 1/

Car 1, PFE 8803 Standard refrigeration to Huntingdon, Pa.  
Vents open Huntingdon to Jersey City. No fan service.

Loading completed	Rusk	June 13	5:00 p.m.	- - - -
Initial icing	Rusk	June 13	5:00 p.m.	11,500 lbs.
1st reicing	Tyler	June 14	4:10 p.m.	8,000 lbs.
2nd reicing	Pine Bluff	June 15	6:50 a.m.	3,000 lbs.
3rd reicing	E. St. Louis	June 15	9:00 p.m.	1,800 lbs.
4th reicing	Decatur	June 16	6:30 a.m.	1,200 lbs.
5th reicing	Columbus	June 16	10:40 p.m.	1,200 lbs.
6th reicing	Huntingdon	June 17	3:15 p.m.	1,800 lbs.
			Total	28,500 lbs.

Bunker inspection upon arrival: 5,200 lbs.

Car 2, FGE 36748 Rule 247: Diagonal vents open E. St. Louis to Jersey City. No fan service.

Loading completed	Jacksonville	June 13	6:30 p.m.	- - - -
Initial icing	Jacksonville	June 13	6:30 p.m.	9,600 lbs.
1st reicing	Pine Bluff	June 14	1:20 p.m.	6,000 lbs.
			Total	15,600 lbs.

Bunker inspection in E. St. Louis: 7,200 lbs.

Car 3, PFE 9483 Rule 247: Diagonal vents open Pine Bluff to Chicago. Fan service.

Loading completed	Jacksonville	June 13	7:30 p.m.	- - - -
Initial icing	Jacksonville	June 13	6:15 p.m.	11,500 lbs.
1st reicing	Pine Bluff	June 14	1:20 p.m.	7,500 lbs.
			Total	19,000 lbs.

Bunker inspection in E. St. Louis: empty

1/ Icing records on test cars were made available by:

St. Louis Southwestern Railway Lines - Tyler, Texas  
 Wabash Railroad Company - St. Louis, Missouri  
 Fruit Growers Express Company - Washington, D. C.



Table 2. Arrival Condition and Ripening Data  
of Tomatoes in Test Lugs

Car No.	Color Upon Unloading*						Firm Ripe at Each Inspection (Cumulative)										
	Total No.	%	%	%	%	%	Total No.	%	%	%	%	%					
Car 1 PFE 8803 Std. Refrig. New York City June 18	TD 208	89.4	3.8	2.9	2.9	1.0	8.2	-	24.5	-	37.5	-					
	BB	208	98.5	0.5	0.5	0.5	0	1.0	-	2.4	-	6.7	-				
												Placed in ripening room June 22					
Car 2 FGE 36748 Rule 247 Jersey City June 18	TD 214	81.3	10.8	2.3	2.8	2.8	19.2	-	-	46.3	-	-	67.3	87.4	96.7	1.9	11.4
	BB	-	-	-	-	-	-	-	-	-	-	-	Placed in ripening room June 19-	-	-	-	-
Car 3 PFE 9483 Rule 247 Chicago June 16	TD 213	92.0	-	3.8	-	4.2	-	39.4	76.1	-	96.7	-	-	-	-	0	1.4
	BB	-	-	-	-	-	-	-	-	-	-	-	Placed in ripening room June 18-	-	-	-	-

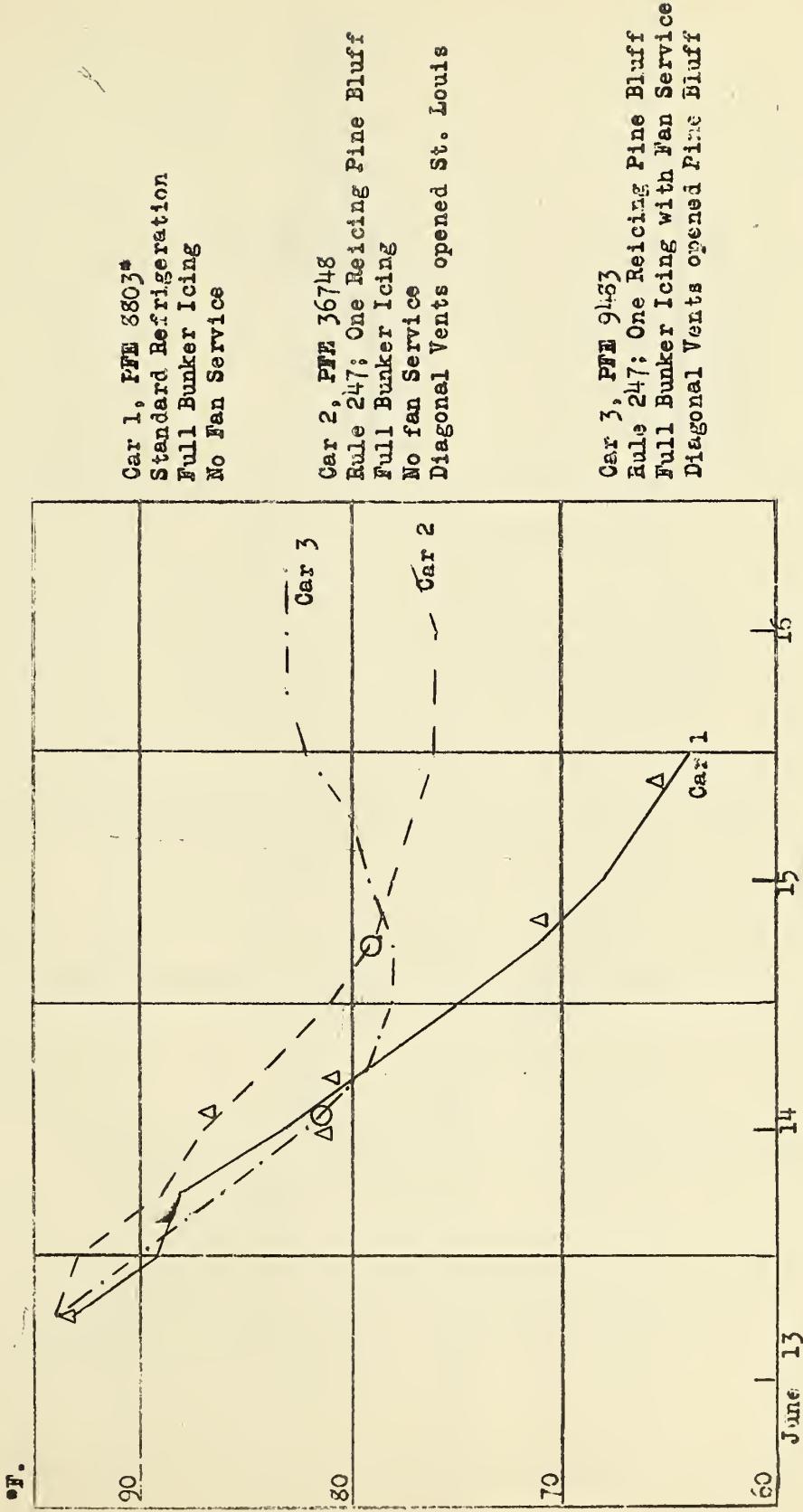
\* Slight turning 0-25% pink color; Medium 26-50%; Advanced 51-75%; Firm Ripe 76-100%.

\*\* Does not include 1.9% discarded because of worm damage.



Figure 1.—Tomato Shipping Test—Jacksonville, Taxes to Chicago and Jersey City  
June 1952

Effect of Different Icing and Ventilation Services on Temperatures  
In Packed Lugs in Top Doorway During First 72 Hours in Transit



o Car 1 not released in time for first train.  
traveled about 18 hours behind Cars 2 and 3 to E. St. Louis.

○ Diagonal Vents Opened  
△ Icing Points



Figure 2.--Tomato Shipping Test - Jacksonville, (Rusk) Texas to Jersey City

June 1952  
Effect of Two Different Icing and Ventilation Services on Temperatures in Packed Lugs in Top Doorway During Transit

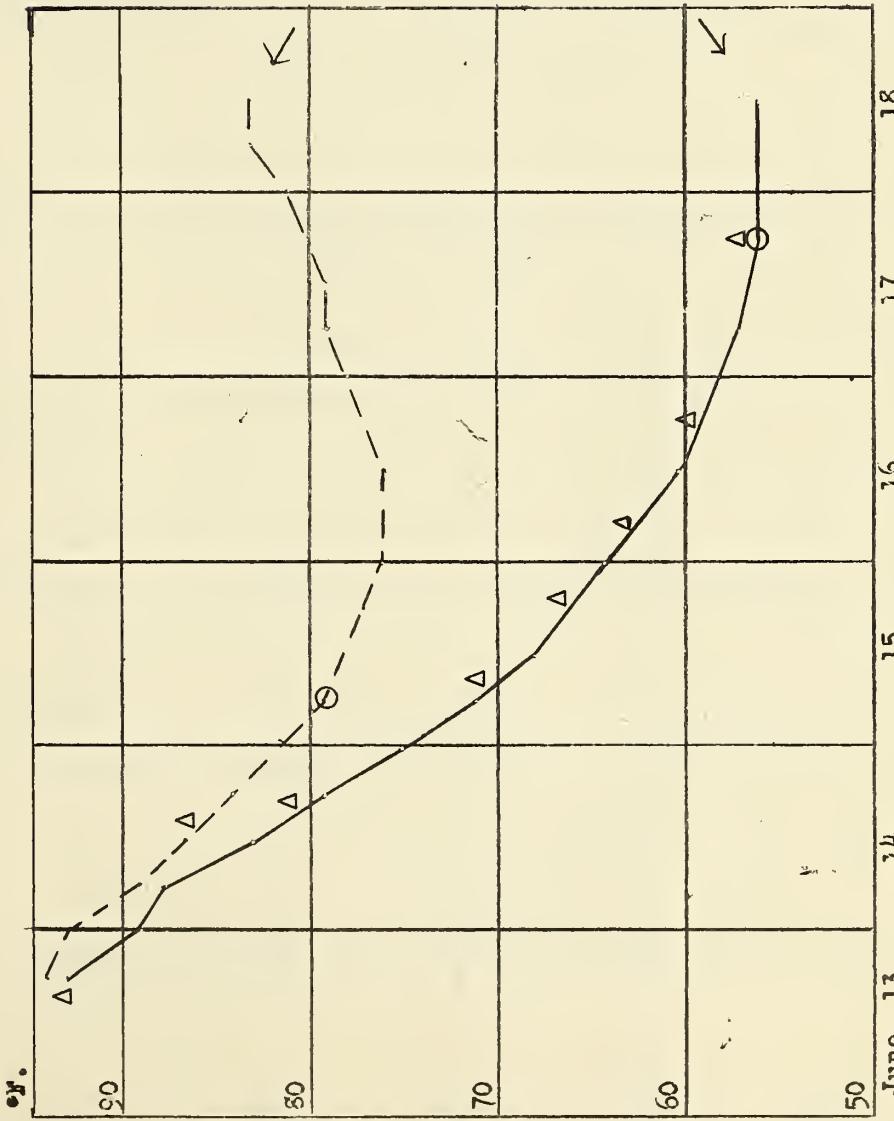




Figure 3.—Tomato Shipping Test — Bush, Texas to Jersey City, June 1952  
 Temperatures in Packed Lugs in Top Doorway and Bottom Bulkhead  
 Location During Transit and Holding on Track

